

## CLAIMS

What is claimed is:

1. A Digital Subscriber Line Access System for providing a plurality of digital subscriber lines comprising at least one Digital Subscriber Line Access Multiplexer, hereafter referred to as DSLAM, realized by a DSL Central Termination Unit, hereafter referred to as DTU-C, at least one Remote Termination Unit, hereafter referred to as DTU-R, and transmission network connecting the DTU-Cs and the at least one DTU-R,
  - the at least one DTU-R comprising
    - an analog front end (AFE) for each of the plurality of DSL lines, for converting DSL signals,
    - a multiplexer/de-multiplexer unit for combining and separating multiple converted DSL signals,
    - a network interface for transmitting and receiving combined multiple converted DSL signals, and
  - the transmission network transmitting said combined multiple converted DSL signals, and
  - a DTU-C comprising
    - a network interface for transmitting and receiving said combined multiple converted DSL signals,
    - a multiplexer/de-multiplexer unit for combining and separating said multiple converted DSL signals, and
    - a digital back end for each DSL line, for modulating and de-

modulating the converted DSL signal, and

- a line interface,

wherein

- the DTU-R comprises for upstream
  - an analog-to-digital converter for each DSL line, for digitizing modulated electrical DSL line signal,
  - a signal processor per DSL line, for converting the digitized electrical modulating DSL line signal,
  - a multiplexer, for combining the converted digitized electrical modulated DSL line signals,
  - an electrical-to-optical converter, for framing and converting the multiplexed converted digitized electrical modulated DSL line signal into an optical signal,

said transmission network being an optical network, transmitting said optical signal, and
- the DTU-C comprising for upstream
  - an optical-to-electrical converter, for converting and de-framing the optical signal into the multiplexed converted digitized electrical modulated DSL line signal,
  - a demultiplexer, for separating the converted digitized electrical modulated DSL line signals,
  - a signal processor for each DSL line, for converting and demodulating the converted digitized electrical modulated DSL line signal for a line interface module, and
- the DTU-C comprising for downstream
  - a signal processor for each line interface, for modulating and converting digitized electrical DSL line signals,
  - a multiplexer for combining the converted digitized electrical modulated DSL line signals,

- an optical-to-electrical converter, for converting and framing the multiplexed converted digitized electrical modulated DSL line signal into an optical signal, and
- the DTU-R comprising for downstream
  - an electrical-to-optical converter, for de-framing and converting the optical signal into the multiplexed converted digitized electrical modulated DSL line signal,
  - a de-multiplexer, for separating the converted digitized electrical modulated DSL line signals,
  - a signal processor for each DSL line, for converting the converted digitized electrical modulated DSL line signal,
  - a digital-to-analog converter for each DSL line, for converting the digitized electrical modulated DSL signal into an electrical modulated DSL signal.

2. A DTU-R for a DSL access system comprising

- at least one analog front end (AFE) for each DSL line, for converting DSL signals,
- a multiplexer/demultiplexer unit for combining and separating multiple converted DSL signals, and
- a network interface for transmitting and receiving combined multiple converted DSL signals,

wherein the DTU-R comprises for upstream

- an analog-to-digital converter for each DSL line, digitizing modulated electrical DSL line signal,
- a signal processor for each DSL line, for converting the digitized electrical modulating DSL line signal,
- a multiplexer, for combining the converted digitized electrical modulated DSL line signals,

- an electrical-to-optical converter, for framing and converting the multiplexed converted digitized electrical modulated DSL line signal into an optical signal,

and wherein the DTU-R comprises for downstream

- an electrical-to-optical converter, for de-framing and converting the optical signal into the multiplexed converted digitized electrical modulated DSL line signal,
- a de-multiplexer, for separating the converted digitized electrical modulated DSL line signals,
- a signal processor for each DSL line, for converting the converted digitized electrical modulated DSL line signal
- a digital-to-analog converter for each DSL line, converting the digitized electrical modulated DSL signal into an electrical modulated DSL signal.

### 3. A DTU-C for a DSL Access System comprising

- a network interface for transmitting and receiving combined multiple converted DSL signals,
- a multiplexer/demultiplexer unit for combining and separating said multiple converted DSL signals,
- a digital back end (Dig) for each DSL line, for modulating and de-modulating converted DSL signal, and
- a line interface,

wherein the DTU-C comprises for upstream

- an optical-to-electrical converter, for converting and de-framing the optical signal into the multiplexed converted digitized electrical modulated DSL line signal,
- a demultiplexer, for separating the converted digitized electrical modulated DSL line signals,

- a signal processor for each DSL line, for converting and demodulating the converted digitized electrical modulated DSL line signal for a line interface module, and

wherein the DTU-C comprises for downstream

- a signal processor for each line interface, for modulating and converting digitized electrical DSL line signals,
- a multiplexer, for combining the converted digitized electrical modulated DSL line signals,
- an optical-to-electrical converter, for converting and framing the multiplexed converted digitized electrical modulated DSL line signal into an optical signal.

4. The DSL Access System according to claim 1, wherein

- the DTU-R's Digital Signaling Processor, hereafter referred to as DSP, comprises for upstream an up-sampling unit, followed by an RF ingress cancellation unit, followed by a band-pass pair, followed by a down converter for each split path (optional), an adding unit, and followed by a heavy down sampling unit (optional), and an optional nonlinear quantization compression unit, and
- the DTU-C's DSP comprises for upstream an optional nonlinear quantization compression unit, followed by a heavy up-sampling unit, followed by a band-pass pair, followed by a down converter for each split path (optional), an adding unit, and followed by a down sampling unit (optional), and
- the DTU-R's DSP comprises for downstream an optional nonlinear quantization compression unit, followed by a heavy up-sampling unit, followed by a band-pass pair, followed by an equalizer (optional), and a down converter for each split path (optional), an adding unit, and followed by a down sampling unit (optional), and

- the DTU-C's DSP comprises for downstream an up-sampling unit, followed by an equalizer (optional), followed by a band-pass pair, followed by a down converter for each split path (optional), an adding unit, and followed by a heavy down sampling unit (optional) and an optional nonlinear quantization compression unit.
5. The DTU-R according to claim 2, wherein
- the DTU-R's DSP comprises for upstream an up-sampling unit, followed by an RF ingress cancellation unit, followed by a band-pass pair, followed by a down converter for each split path (optional), an adding unit, and followed by a heavy down sampling unit (optional), and an optional nonlinear quantization compression unit, and
  - wherein the DTU-R's DSP comprises for downstream an optional nonlinear quantization compression unit, followed by a heavy up-sampling unit, followed by a band-pass pair, followed by an equalizer (optional), and a down converter for each split path (optional), an adding unit, and followed by a down sampling unit (optional).
6. The DTU-C according to claim 3,
- wherein the DTU-C's DSP comprises for upstream an optional nonlinear quantization compression unit, followed by a heavy up-sampling unit, followed by a band-pass pair, followed by a down converter for each split path (optional), an adding unit, and followed by a down sampling unit (optional), and
  - wherein the DTU-C's DSP comprises for downstream an up-sampling unit, followed by an equalizer (optional), followed by a band-pass pair, followed by a down converter for each split path (optional), an adding unit, and followed by a heavy down sampling unit (optional) and an optional nonlinear quantization compression unit.